

REMARKS

Status of Application

Claims 1-10 are pending. The remaining claims have been withdrawn by the Examiner as directed to non-elected inventions. These claims have been cancelled without prejudice to their prosecution in other application(s).

Claim Rejections

The Office Action repeats that claims 1-3 and 5-10 are rejected under 35 U.S.C. § 102 (b) as being anticipated by US Patent No. 4,874,739 by Boxhoorn, in view of US Patent No. 6,417,136 by Cheung, et al. Applicant will respond to this rejection as a rejection under 35 U.S.C. § 103, because that was the patent code section set forth as well because the combination of two references were cited. It is established law that: "A claim is anticipated only if *each and every* element as set forth in the claim is found, either expressly or inherently described, in a *single* prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987) (emphasis added)

As recognized by the Examiner, "Boxhoorn does not explicitly teach calcining subsequent to impregnation with the alkali metal salt" (page 3). The only express teaching Boxhoorn contains with regard to *impregnation* with an alkali metal compound is summarized in step (c) of claim 1 of Boxhoorn, where one or more alkali metal compounds are used to impregnate the carrier *before*, during or after impregnation of the carrier with a silver compound. As explained in the specification, the purpose of the impregnation of the carrier with these alkali metal compounds is to provide a *promoter* which enhances the catalytic properties of the silver catalyst:

Also a *promoter* is present on the surface of the carrier, for example one or more alkali metals, for example potassium, rubidium or cesium. The promoters can be applied on the carrier before, during or after the impregnation with the silver compound. The promoter can also be applied on the carrier after the silver compound has been reduced to silver. The silver and the promoter are on the surface of the alumina carrier and exercise their catalytic action there.

Boxhoorn, Col. 3, lines 20-29.

Boxhoorn does not teach any form of heat treatment after impregnating the alkali metal salt promoter *without* the silver on the preformed carrier. The preferred process consists of the carrier being impregnated with an aqueous solution containing *both alkali metal salt and silver salt*. After impregnating that combination solution, Boxhoorn teaches *not to calcine* but merely to heat the impregnated carriers to a temperature of between 100 and 400°C, preferably between 125 and 325°C. (Col. 5, lines 38- 41) In Examples 1 and 2, the drying temperatures are 250 to 270°C. Boxhoorn teaches heating at much lower temperatures than the calcination temperatures suitable for modifying carriers as taught in the present application to reduce the silver salt to silver metal. Those of skill in the art are aware that heating the silver to calcining conditions with or without the presence of the promoter would result in non-desirable silver sintering. Boxhoorn itself recognizes this by cautioning that “temperatures above 400°C during long times should be avoided, since then sintering of the silver particles takes place”. (Col. 4, lines 26-28.)

The Examiner turns to catalyst art other than catalysts for ethylene oxide to find a calcination step and the alleged motivation for using that calcination step after impregnation of a metal salt onto a preformed carrier. The Examiner characterizes Cheung as being drawn to a hydrocarbon hydrogenation catalyst and process of making. The Examiner cites Cheung as teaching calcining a metal-incorporated alumina to produce a carrier (claim 1) wherein the metal is incorporated by impregnation (claim 2), and that Cheung teaches that the process can involve the following steps: impregnating the alumina carrier with palladium, drying, calcining, then impregnating with a catalyst component, drying and calcining (claim 65). Finally, the Examiner finds that Cheung teaches the addition of both silver and an alkali metal compound impregnated by an alkali metal hydroxide (col 6, lines 30-65).

The Examiner concludes that at the time of invention, it would have been obvious to a person of ordinary skill in the art to perform the process of Boxhoorn including the addition of a subsequent calcining step after impregnation with the alkali metal salt, in view of the teaching of Cheung. The Examiner finds the suggestion or motivation for doing so would have been to produce a carrier and catalyst having

preferred and suitable physical features of surface area, pore volume, average pore diameter, and crystalline domain size, citing to Cheung at col. 14, lines 45-49.

Applicant respectfully submits that: (1) Cheung is not analogous art; and (2) the teachings of Cheung do not provide a sufficient basis for suggestion or motivation to combine the teachings of Cheung and Boxhoorn.

The art relevant to a consideration of obviousness is the analogous art. *Wang Lab., Inc. v. Toshiba Corp.*, 993 F.2d 858, 864 (Fed. Cir. 1993). Non-analogous art is too remote to constitute prior art. *In re Clay*, 966 F.2d 656, 658 (Fed. Cir. 1992). Two criteria determine whether a particular reference is analogous art. First, if the reference is within the inventor's field of endeavor, then it is deemed analogous. *Wang*, 993 F.2d at 864; *Clay*, 966 F.2d at 659; *Bausch & Lomb, Inc.*, 796 F.2d at 449. Second, if the reference is reasonably pertinent to the particular problem with which the inventor was involved, it is prior art. *Wang*, 993 F.2d at 864; *Clay*, 966 F.2d at 659; *Bausch & Lomb, Inc.*, 796 F.2d at 449. The Federal Circuit explained in *Clay*:

A reference is reasonably pertinent if, even though it may be in a different field from that of the inventor's endeavor, it is one which, because of the matter with which it deals, logically would have commended itself to an inventor's attention in considering his problem. Thus, the purposes of both the invention and the prior art are important in determining whether the reference is reasonably pertinent to the problem the invention attempts to solve. If a reference disclosure has the same purpose as the claimed invention, the reference relates to the same problem, and that fact supports use of that reference in an obviousness rejection. An inventor may well have been motivated to consider the reference when making his invention. If it is directed to a different purpose, the inventor would accordingly have had less motivation or occasion to consider it.

The Examiner maintains that Cheung is a proper reference as both the claimed invention and Cheung are "strongly rooted in the field of catalysis". However, as noted by the examiner, Cheung is directed to making and using a catalyst support and catalyst for the *hydrogenation* of "highly unsaturated hydrocarbons" such as an alkyne or a diolefin. Hydrogenation is a chemical reaction where, for example, a molecule such as oxygen is removed or a molecule such as hydrogen is added. The claims of the present invention are directed to a method of modifying a carrier for a catalyst to be used for the vapor phase *epoxidation* of ethylene and a method of

preparation of a catalyst to be used for the vapor phase *epoxidation* of ethylene. Ethylene epoxidation is a reaction where olefins are combined with molecular oxygen. Thus, the chemical reactions occurring in Cheung and Boxhoorn are opposite in nature, not analogous. Even within the field of *epoxidation* catalysis, it is recognized that catalysts which provide benefits for the epoxidation of ethylene are not helpful in the epoxidation of higher olefins. See, e.g., Monnier, The Role of Alkali Promoters in the Ag-catalyzed Epoxidation of Olefins, 234th ACS National Meeting, Boston, MA, United States, August 19-23, 2007 (2007) (cesium promoted silver based catalysts used in epoxidation of higher olefins have higher activity, selectivity, and extended catalyst lifetimes, whereas cesium promoted silver catalyst used to epoxidate ethylene oxide increase selectivity at the expense of activity; rubidium and titanium promoters exhibit similar behavior similar to cesium for butadiene epoxidation, while potassium promoters have no effect on Ag for butadiene epoxidation); Monnier, et al., Stability and Distribution of Cesium in Cesium Promoted Silver Catalysts used for Butadiene Epoxidation, Journal of Catalysis (2004), 226(2), 401-409 (catalysts used for butadiene epoxidation contain much higher levels of cesium promoters (600-1400 ppm) compared to catalysts used for ethylene epoxidation (200-400 ppm)); Monnier, et al., The Direct Epoxidation of Higher Olefins using Molecular Oxygen, Applied Catalysis, A: General (2001), 221(1-2), 73-91 (optimum catalyst formulations for propylene or C4 epoxidation are different from those for ethylene epoxidation). Where one of skill in the art of making improved carriers for ethylene oxide epoxidation catalysts would not look to art applicable to other epoxidation reactions, that person would certainly not look to art concerning the hydrogenation of an alkyne or a diolefin. Nor, as explained more fully below, is the problem sought to be solved by the present invention the same or similar to the problem sought to be solved by Cheung.

Cheung teaches a process for making a metal aluminate support. This metal alumina support is made by incorporating a metal component, preferably a melted metal component, on an alumina. (Col. 8.) The alumina can be alpha alumina; a preferred alumina is gamma alumina. (Col. 8) It can be desirable to use an aqueous solution of a metal component for the impregnation of the alumina and a preferred solution comprises an aqueous solution formed by dissolving a metal component, such as a metal component in the form of a metal salt. Sodium is noticeably absent from the recitation of potentially suitable metal components, let alone the preferable and

more preferable metal components. The incorporation of the metal results in a metal-incorporated alumina which can then be dried and calcined to thereby provide a metal aluminate support. The amount of metal added is from 1 wt % to 100 wt % of the total catalyst support.

The *purpose* of the calcination condition in providing the metal aluminate catalyst support is explained in Cheung at Col. 14, lines 45-49 which provides:

The calcining condition is important in providing a *metal aluminate catalyst support* having physical characteristics, such as for example a surface area, pore volume, average pore diameter, and crystalline domain size, *in the ranges disclosed herein*, suitable for using such metal aluminate catalyst support as a support for *hydrogenation and dehydrogenation* catalysts.

(emphasis added).

The surface areas and average pore diameter of the Cheung starting material prior to the creation of the metal aluminate support are very different than those of the resulting metal aluminate support.

Carrier Property (Cheung)	Measurement Prior to Creation of Metal Aluminate Support	Measurement After Creation of Metal Aluminate Support
Surface Area m ² /g	5 to 400 10 to 300 50 to 200 (col. 8, lines 58-62)	1 to 200 1 to 150 5 to 125 10 to 80 (col. 15, lines 57-64)
Pore volume (mL/g)	0.05 to 2 0.10 to 1.5 0.20 to 1 (col. 8, lines 63- 65)	0.05 to 2 0.10 to 1.5 0.10 to 1
Ave Pore diameter (Å)	5 to 600 10 to 500 25 to 200 (col. 8, line 66- col. 9, line 3)	50 to 1000 50 to 750 50 to 450

Moreover, the surface area and pore diameter (and particularly the pore diameter) of Boxhoorn are very different from those of either the starting material or the metal alumina support taught in Cheung. Thus, there would be no reason for one of skill in the art to look to Cheung for ways to alter the properties of the Boxhoorn carrier as Cheung is limited to teaching that the treatment is applicable to achieve its results *in the desired range*.

Carrier Property	Cheung-Raw Material	Cheung-Metal Aluminate Support	Boxhoorn
Surface Area m ² /g of raw material	5 to 400 10 to 300 50 to 200 (col. 8, lines 58-62)	0 to 200 1 to 150 5 to 125 10 to 80 (col. 15, lines 57-64)	0.1 to 5 0.2 to 2 (col 3, lines 5-9)
Pore volume (mL/g) of raw material	0.05 to 2 0.10 to 1.5 0.20 to 1 (col. 8, lines 63- 65)	0.05 to 2 0.10 to 1.5 0.10 to 1	0.55 (Example 1) 0.59 (Example 2)
Pore diameter (microns) of raw material	Ave (converted to microns) 0.005 to 0.600 0.010 to .0500 0.025 to .0200 (col. 8, line 66- col. 9, line 3)	0.050 to 1.00 0.050 to .750 0.050 to .450	Ave 2.6 (Example 1) 2.4 (Example 2)

Further, as noted in the present application:

the modification according to the present invention can be conducted in such a way that properties of the surfaces of the microscopic alumina particles can be affected *without substantially altering the morphology, surface area, pore volume, pore size distribution and/or bulk density of the calcined alumina*. As a result, where preformed alumina having shape, morphology, surface area, pore volume, pore size distribution and bulk density which are desirable for a carrier is modified in accordance with the present invention, the resulting shape, morphology, surface area, pore volume, pore size distribution and bulk density of the modified alumina carrier are likewise desirable for a carrier. Accordingly, the preformed alumina preferably has shape, morphology, surface area, pore volume, pore size distribution and bulk density shape which are desirable for alumina carrier.

(page 5 lines 11-21)(emphasis added)

According to teachings of the present application, one of skill in the art begins with a calcined alumina that is *already* suitable for use as a carrier as is. Then, a desirable chemical modification is made to further improve catalyst performance without substantially altering the physical properties of the support. One of skill in the art, then, would not combine a step from Cheung, directed to accomplishing a

very different result than the treatment of the present invention, to alter the teachings of Boxhoorn to arrive at the claimed invention.

Cheung further teaches taking its metal aluminate support and using it as a catalyst support. The catalyst is made of palladium in the skin of the metal aluminate support, with a catalyst component of silver and/or an alkali metal compound. Whether silver and/or the alkali metal compound are used as the catalyst, they are impregnated upon the support. Whether silver and/or the alkali metal compound are impregnated, a *calcination* step follows. For the reasons taught by Boxhoorn, one of skill in the art would not follow an impregnation step involving silver with a calcination step. Cheung *equates* silver and the alkali metal compound and, post-impregnation, treats them the same. One of skill in the art would not separate the teachings of Cheung to go against the express teaching of Boxhoorn to calcine an impregnated alkali metal compound.

Claim 4 is rejected under 35 U.S.C. § 103 (a) as being unpatentable over US Patent No. 4,874,739 by Boxhoorn in view of US Patent No. 6,417,136 by Cheung et al, as applied to claim 1 or 2 above, in view of US Patent No. 4,994,589 by Notermann. Applicants respectfully traverse this rejection. Claim 4 is dependent on claim 1 or 2. Given that claims 1 and 2 are patentable, claim 4 is as well.

Applicants respectfully requests consideration of the rejection of claims 1-10 and further submit that claims 1-10 are in condition for allowance.

Respectfully submitted,

/Lois K. Ruzala/Reg No 39074/

Lois K. Ruzala
Registration No. 39,074
Phone: (989) 636-1556

P. O. Box 1967
Midland, MI 48641-1967

LKR/sdk